Technical Report No.: 60.870.13.030.01S

Dated: 2013-09-25

CLIENT:

Company Name:	XiangDe electronic technology (Shen Zhen)Co,.LTD
Address:	BlgC16 Fuyan Industrial Area,No 111, Zhoushi Road,Xixiang Street, Baoan, Shenzhen City, China

MANUFACTURING PLACE:

Company Name:	XiangDe electronic technology (Shen Zhen)Co,.LTD
Address:	BlgC16 Fuyan Industrial Area,No 111, Zhoushi Road,Xixiang Street, Baoan, Shenzhen City, China

TEST SUBJECT:

Product :	7" MID
Model :	PI070H04AA
FCC ID :	RQ2PI070H04AA

TEST SPECIFICATION:

> FCC 47 CFR Part 2 (2.1093); ANSI/IEEE C95.1-1992;
> IEEE 1528-2003 ; FCC OET Bulletin 65C (Edition 01-01)

TEST RESULTS: **POSITIVE**

Positive: The results show that the presented product is in compliance with the specified requirements.
Negative: The present test results show that after removal of the points of non-compliance as listed in the report and an appropriate retest the product is in compliance with specified requirements. A retest of a modified product is necessary. A certification can be recommended at a positive result.

This report may only be quoted in full. Any use for advertising purposes must be granted in writing. This report is result of a single examination of the object in question and is not generally applicable evaluation of the quality of other products in regular production.

TÜV SÜD South Region Report Template No. (TEL_SR_F_12.30E)

This test report has total number of pages is 94.

Prepared by: Jim Huang	Reviewed by: John Zhi
(signature)	*(signature)*
Project Engineer	Project Manager
Date: 2013-09-25	Date: 2013-09-25

TABLE OF CONTENTS

1. General Information

1.1 Product Description for Equipment Under Test (EUT)

General Description of EUT	
Product Name:	7" MID
Trade Name:	N/A
Model No.:	PI070H04AA
Hardware Version:	V3.0
Software Version:	Android 4.1
IMEI:	N/A
Device Category:	Portable Device
RF Exposure Environment:	General Public
Rated Voltage:	DC 3.7V
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Wi-Fi	
Support Standards:	802.11b, 802.11g, 802.11n
Frequency Range:	2412-2462MHz for 11b/g/n-HT20 2422-2452MHz for 11n-HT40
RF Output Power:	18.51 dBm (Conducted)
Modulation Type:	CCK, OFDM
Data Rate:	1-11Mbps, 6-54Mbps, up to 150Mbps
Antenna Type:	Internal Antenna
Antenna Gain:	2.0 dBi

1.2 Test Standards

In accordance with FCC 47 CFR Part 2.1093, ANSI/IEEE C95.1-1992, IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

The objective is to determine compliance with FCC Part 2.1093 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with FCC OET Bulletin 65 Supplement C. The public notice KDB 447498 D01 V05 for Mobile and Portable Devices RF Exposure Procedure also.

1.4 Test Facility

CNAS-Lab Code: L1659
CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. CCIC is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659. A 12.8*6.8*6.4 (m) fully anechoic chamber was used for the radiated spurious emissions test.

FCC-Registration No.: 406086
CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 406086, Renewal date Nov. 19, 2011, valid time is until Nov. 18, 2014.

2. Summary of Test Results

The maximum results of   Specific Absorption Rate (SAR) have found during testing are as follows:

Frequency Band	Position	SAR_{1g} (W/kg)	Scaled SAR_{1g} (W/kg)
GSM850	Head	---	---
GSM1900	Head	---	---
WCDMA Band V	Head	---	---
WLAN 2.4GHz	Head	---	---
GSM850	Body	---	---
GSM1900	Body	---	---
WCDMA Band V	Body	---	---
WLAN 2.4GHz	Body	**0.2172**	**0.342**

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR Part 2.1093 and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedure specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

3. Specific Absorption Rate (SAR)

3.1 Introduction

   SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techiques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

3.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{\rho dv}}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\mathbf{\delta T}}{\mathbf{\delta t}}\right)$$

Where: C is the specific heat capacity, δ T is the temperature rise and δ t is the exposure duration, or related to the
electrical field in the tissue by

$$\mathbf{SAR} = \frac{\mathbf{\sigma |E|^2}}{\mathbf{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.
However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

4. SAR Measurement System

4.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:
- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Phone holder
- Head simulating tissue

The following figure shows the system.
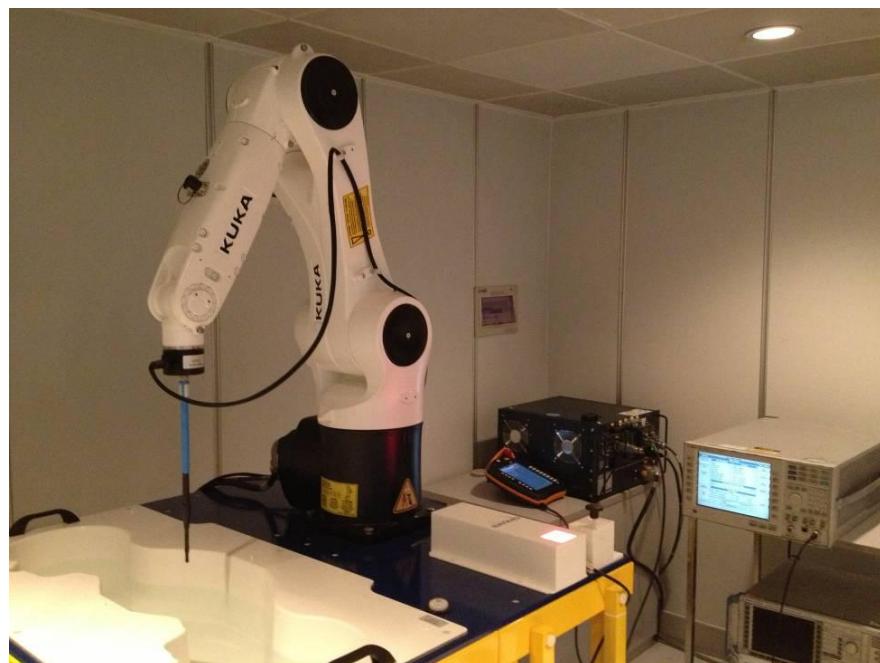
The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

4.2 Probe

For the measurements the Specific Dosimetric E-Field Probe SSE5 SN 22/12 EP155 with following specifications is used
- Dynamic range: 0.01-100 W/kg

- Probe Length: 330 mm
- Length of Individual Dipoles: 4.5 mm
- Maximum external diameter: 8 mm
- Probe Tip External Diameter : 5 mm
- Distance between dipoles / probe extremity: 2.7mm
- Probe linearity: ＜0.25 dB
- Axial Isotropy: ＜0.25 dB
- Spherical Isotropy: ＜0.50 dB
- Calibration range: 700 to 3000MHz for head & body simulating liquid.
Angle between probe axis (evaluation axis) and suface normal line:1ess than 30°

Probe calibration is realized, in compliance with EN 62209-1 and IEEE 1528 STD, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1 annexe technique using reference guide at the five frequencies.
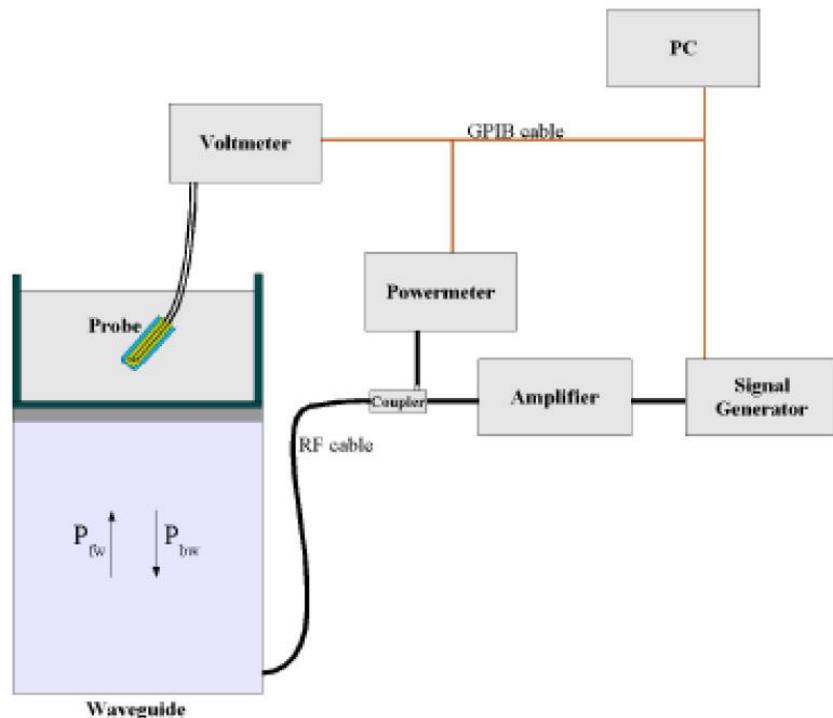
$$SAR = \frac{4\left(P_{fw} - P_{bw}\right)}{ab\delta} \cos^2\left(\pi\frac{y}{a}\right) c^{\,(2z/\delta)}$$

Where :

Pfw   = Forward Power

Pbw   = Backward Power

a and b   =Waveguide dimensions

I   =   Skin depth

Keithley configuration:

Rate = Medium; Filter = ON; RDGS = 10; Filter type = Moving Average; Range auto after each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

The calibration factors, CF(N), for the 3 sensors corresponding to dipole 1, dipole 2 and dipole 3 are:

$$CF(N)=SAR(N)/Vlin(N) \ (N=1,2,3)$$

The linearised output voltage Vlin(N) is obtained from the displayed output voltage V(N) using

$$Vlin(N)=V(N)*(1+V(N)/DCP(N)) \ (N=1,2,3)$$

where DCP is the diode compression point in mV.

4.3 Probe Calibration Process

Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. SATIMO Probe calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm2) using an with CALISAR, Antenna proprietary calibration system.

Free Space Assessment Procedure

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1mW/cm2.

Temperature Assessment Procedure

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR \ = \ C\frac{\Delta T}{\Delta t}$$

Where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

Where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm3 for brain tissue)

4.4 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

4.5 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is lower than 1°.
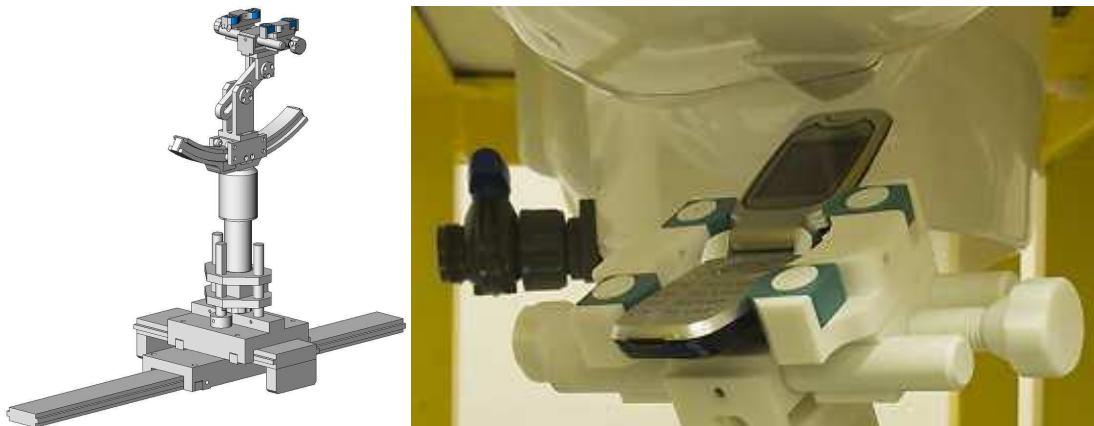
4.6 Test Equipment List

| Equipment description	Manufacturer/Model	Identification No.
SAR Probe	SATIMO	SN_0913_EP169
Phantom	SATIMO	SN_0913_SAM97
Liquid	SATIMO	-
Dipole	SATIMO-SID900	SN_0913_DIP0G900-215
Dipole	SATIMO-SID1800	SN_0913_DIP1G800-216
Dipole	SATIMO-SID2000	SN_0913_DIP2G000-219
Dipole	SATIMO-SID2450	SN_0913_DIP2G450-220
Vector Network Analyzer	Rohde & Schwarz - ZVB8	1145.1010.08
Amplifier	Nucletudes	143060
Power Meter	Rohde & Schwarz - NRVS	1020.1809.02
Multimeter	Keithley - 2000	4014020

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the draft IEEE standard P1528. Setup according to the setup diagram below :
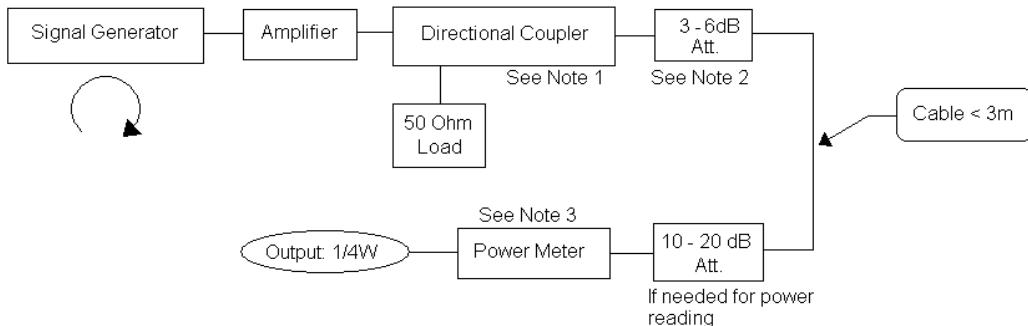
With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.25W (24 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level. If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need

an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 10-gram averaged SAR values of the device against the head and body were provided in Table 4. The humidity and ambient temperature of test facility were 64% and 23.2°C respectively. The phantom was full of the body tissue simulating liquid for body-worn measurement. The EUT was supplied with full-charged battery for each measurement.

For the body-worn measurement, the distance between the back of the EUT and the bottom of the flat phantom is 15 mm (taking into account of the IEEE 1528 and the place of the antenna).

For all of the measurements, the EUT was tested at the lowest, middle and highest frequencies in the transmit band.

5. Tissue Simulating Liquids

5.1 Composition of Tissue Simulating Liquid

For the measurement of the field distribution inside the SAM phantom with SMTIMO, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. Please see the following photos for the liquid height.
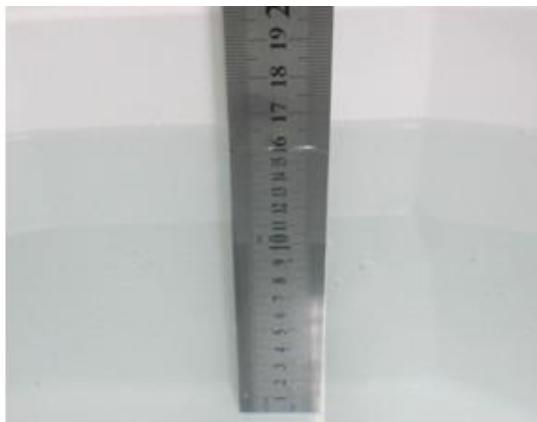
Liquid Height for Head SAR

Liquid Height for Body SAR

The Composition of Tissue Simulating Liquid

Frequency (MHz)	Water (%)	Salt (%)	Triton (%)	HEC (%)	Preventol (%)	DGBE (%)
Head						
---	---	---	---	---	---	---
---	---	---	---	---	---	---
---	---	---	---	---	---	---
Body						
---	---	---	---	---	---	---
---	---	---	---	---	---	---
2450	55.44	0.32	30.50	0.00	0.00	13.74

5.2 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters
computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Target Frequency (MHz)	Head		Body	
	Conductivity (σ)	Permittivity (ε_r)	Conductivity (σ)	Permittivity (ε_r)
150	0.76	52.3	0.80	61.9
300	0.87	45.3	0.92	58.2
450	0.87	43.5	0.94	56.7
835	0.90	41.5	0.97	55.2
900	0.97	41.5	1.05	55.0
915	0.98	41.5	1.06	55.0
1450	1.20	40.5	1.30	54.0
1610	1.29	40.3	1.40	53.8
1800-2000	1.40	40.0	1.52	53.3
2450	**1.80**	**39.2**	**1.95**	**52.7**
3000	2.40	38.5	2.73	52.0
5800	5.27	35.3	6.00	48.2

5.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using COMOSAR Dielectric Probe Kit and an Agilent Network Analyzer.

Calibration Result for Dielectric Parameters of Tissue Simulating Liquid

Head Tissue Simulating Liquid									
Freq. MHz.	Temp. (℃)	Conductivity			Permittivity			Limit (%)	Date
		Reading (σ)	Target (σ)	Delta (%)	Reading (ε r)	Target (ε r)	Delta (%)		
---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---

Body Tissue Simulating Liquid									
Freq. MHz.	Temp. (℃)	Conductivity			Permittivity			Limit (%)	Date
		Reading (σ)	Target (σ)	Delta (%)	Reading (ε r)	Target (ε r)	Delta (%)		
---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---
2450	21.3	2.00	1.95	2.56	52.69	52.7	-0.76	± 5	08-16-2013

6. SAR Measurement Evaluation

6.1 Purpose of System Performance Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high

sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the

calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or

failure.

6.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 835 MHz and 1900 MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom.
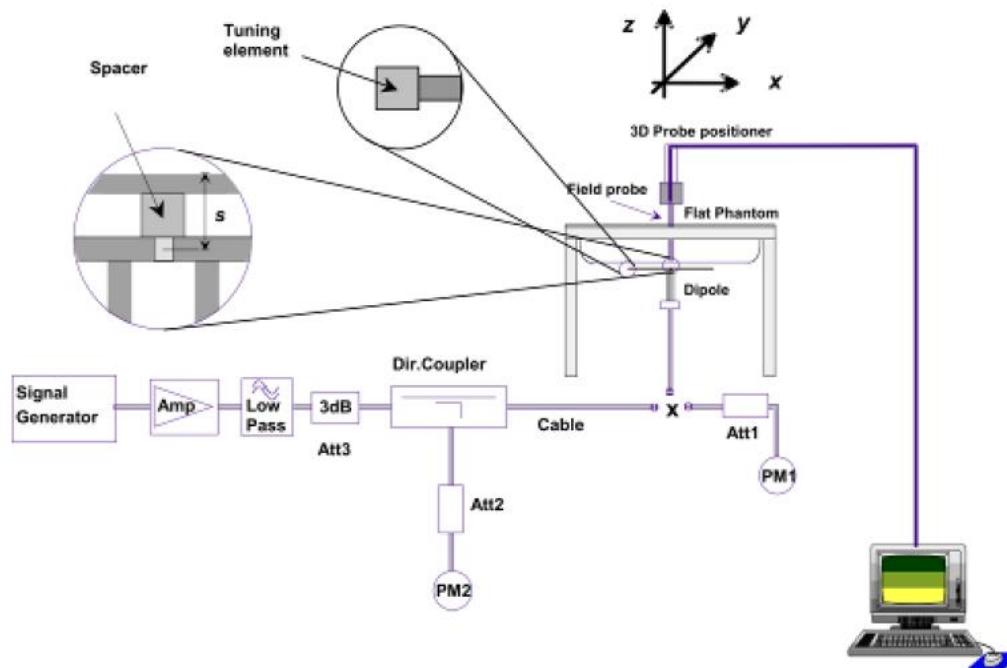

Fig 7.1 System Verification Setup Block Diagram

Fig 7.2 Setup Photo of Dipole Antenna

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.

6.3 Validation Results

Comparing to the original SAR value provided by SATIMO, the validation data should be within its specification of 10 %. Table 6.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion.

Frequency	Liquid	Targeted SAR$_{1g}$	Measured SAR$_{1g}$	Normalized SAR$_{1g}$	Tolerance
MHz	(Head/Body)	(W/kg)	(W/kg)	(W/kg)	(%)
2450	Body	51.80	13.16	51.61	-0.37
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---
---	---	---	---	---	---

Table 7.1 Targeted and Measurement SAR

Please refer to Annex A for the plots of system performance check.

7. EUT Testing Position

7.1 Define Two Imaginary Lines on The Handset

(a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.

(b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic
output. The horizontal line is also tangential to the face of the handset at point A.

(c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.
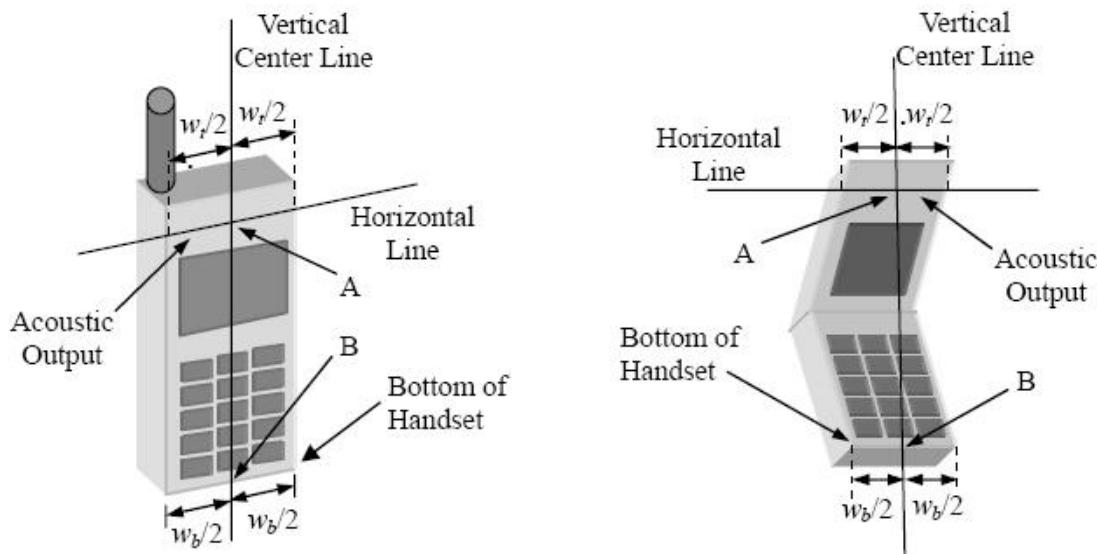

Fig 7.1 Illustration for Handset Vertical and Horizontal Reference Lines

7.2 Cheek Position

(a) To position the device with the vertical center line of the body of the device and the horizontal line crossing

the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.

(b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the

phantom or until contact with the ear is lost (see Fig. 7.2).
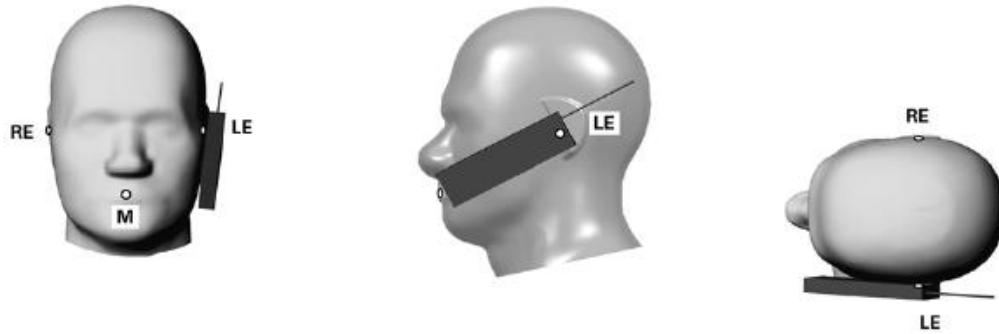
**Fig 7.2 Illustration for Cheek Position**

7.3 Tilted Position

(a) To position the device in the "cheek" position described above.

(b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 7.3).
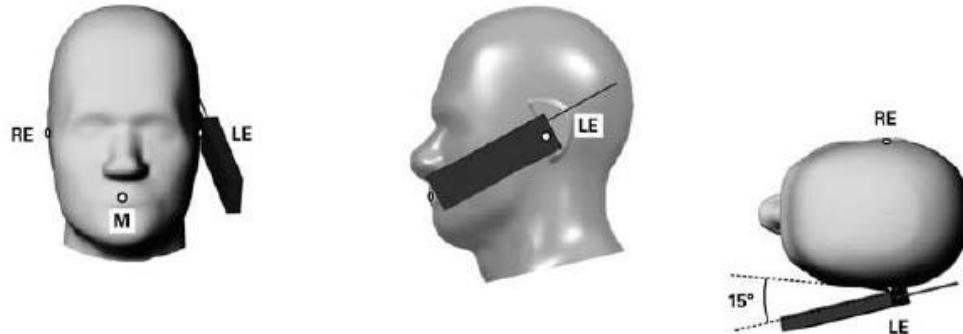
Fig 7.3 Illustration for Tilted Position

7.4 Body Worn Position

(a) To position the device parallel to the phantom surface with either keypad up or down.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 0 cm.
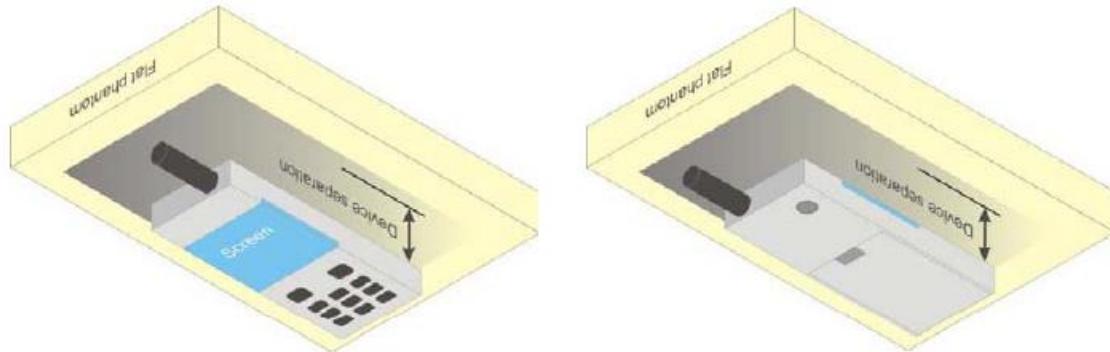
Fig 7.4 Illustration for Body Worn Position

7.5 EUT Antenna Position

There's only one antenna (Wi-Fi antenna) inside the EUT, and it is the transmitting source. The following pictures showed the diagonal dimension (25cm>20cm) of the EUT and position of the antenna:

Diagonal size (21.7cm)
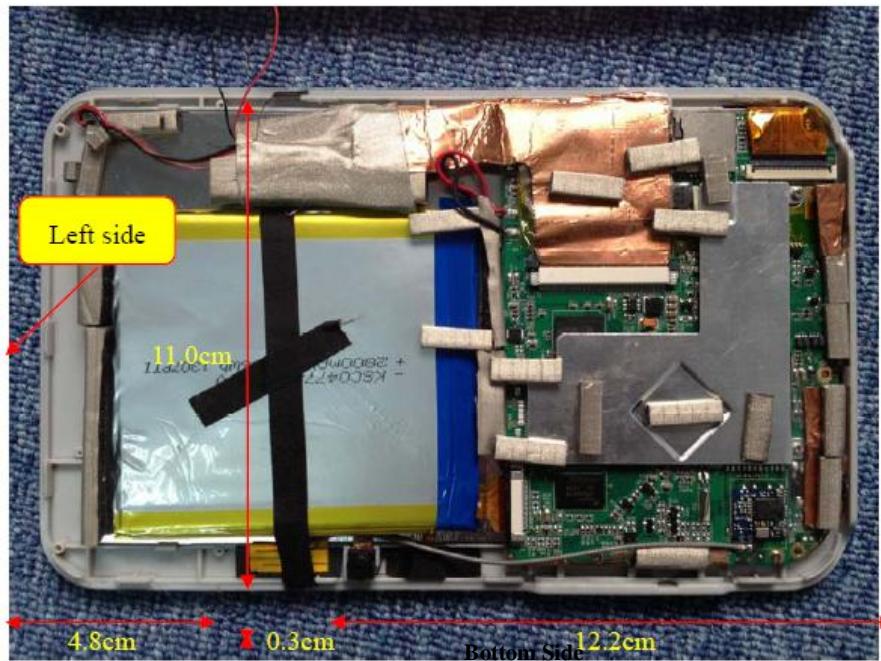
The EUT should be tested under the following positions according to KDB 616217 and KDB447498:

a. Back Upward (the back directly against the phantom);

b. Camera Upward (the side of camera directly against the phantom);

c. Left side Upward (the Left side of EUT directly against the phantom);
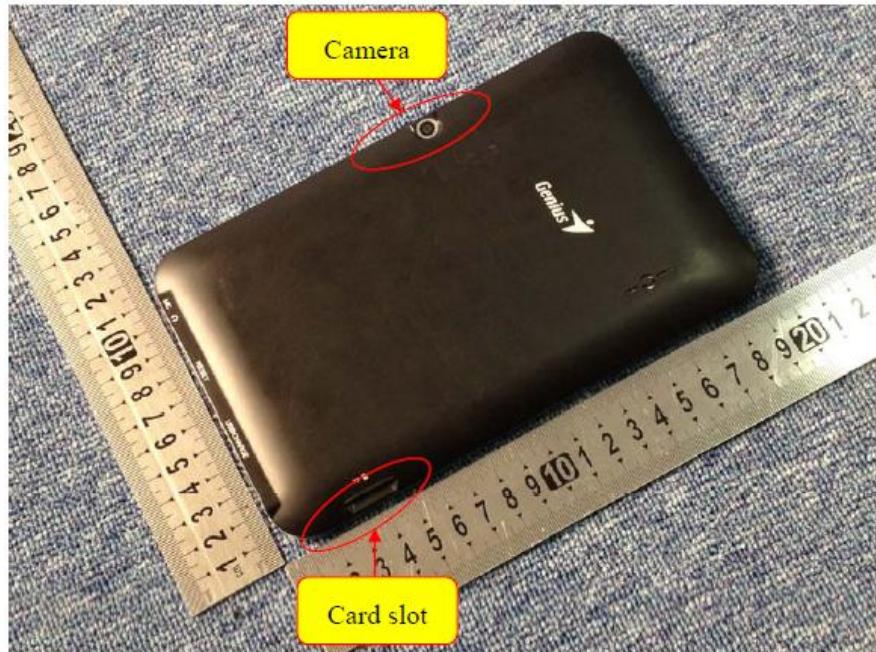
Fig 7.5 Block Diagram for EUT Antenna Position

7.6 EUT Testing Position

Body-worn mode SAR assessments are required for this device. This EUT was tested in different positions for different SAR test modes, more information as below:

All sides for Body SAR tests, Test distance: 0 mm						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Right Side**	**Left Side**
---	---	---	---	---	---	---
WLAN	No	Yes	Yes	No	No	Yes

Remark:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04 and FCC KDB Publication 447498 D01.

SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

2. For WWAN antenna, SAR measurements at Bottom/Left side are not required since the distance between WWAN transmitting antenna and surface or edge > 25mm.

3. For WLAN & Bluetooth antenna, SAR measurements Bottom/Right sides are not required since the distance between WLAN & Bluetooth transmitting antenna and surface or edge > 25mm.

Please refer to Annex D for the EUT test setup photos.

8. SAR Measurement Procedures

8.1 Measurement Procedures

The measurement procedures are as follows:

(a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the highest power channel.

(b) Keep EUT to radiate maximum output power or 100% factor (if applicable)

(c) Measure output power through RF cable and power meter.

(d) Place the EUT in the positions as Annex E demonstrates.

(e) Set scan area, grid size and other setting on the SATIMO software.

(f) Measure SAR results for the highest power channel on each testing position.

(g) Find out the largest SAR result on these testing positions of each band

(h) Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel islarger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR valueconsists of the following steps:

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

8.2 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be

conducted for 1g and 10g, as well as for user-specific masses. The SATIMO software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine. The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan

(b) Calculation of the SAR value at every measurement point based on all stored data

(c) Generation of a high-resolution mesh within the measured volume

(d) Interpolation of all measured values form the measurement grid to the high-resolution grid

(e) Extrapolation of the entire 3D field distribution to the phantom surface over the distance from sensor to surface

(f) Calculation of the averaged SAR within masses of 1g and 10g

8.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

8.4 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency
bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will
be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.5 SAR Averaged Methods

The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimize measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10g and 1 g requires a very fine resolution in the three dimensional scanned data array.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In SATIMO measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

9. SAR Test Result

9.1 Conducted RF Output Power

Test Mode	Data Rate	Channel	Frequency (MHz)	Average Power (dBm)	Scaling Factor
WLAN - Maximum Average Power					
802.11b	1Mbps	CH 01	2412	17.02	1.58
		CH 06	2437	18.44	1.14
		CH 11	2462	**18.51**	1.12
802.11g	54Mbps	CH 01	2412	16.95	1.27
		CH 06	2437	16.57	1.39
		CH 11	2462	16.25	1.50
802.11n (20MHz)	MCS7	CH 01	2412	16.28	1.49
		CH 06	2437	16.24	1.50
		CH 11	2462	16.74	1.34
802.11n (40MHz)	MCS7	CH 03	2422	15.81	1.32
		CH 06	2437	15.86	1.30
		CH 09	2452	16.30	1.17

Remark:

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion

2. Per KDB 248227, if 11g and 11n average output power is higher than 1/4 dB higher than 11b mode, SAR will be verified.

3. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4 dB higher than those measured at the lowest data rate. For 802.11n mode, SAR test according to the highest power channel with correspondence data rates.

9.2 Test Results for Standalone SAR Test

SAR Values of 802.11b

Test Mode	Test Position	SAR(W/Kg), 1.6 (1g average)		
		Channel/		
		1	6	11
802.11b	Back Upward	0.217	0.214	0.212
	Camera Upward	---	0.207	---
	Left side Upward	---	0.086	---

Scaled SAR Values of 802.11b

Test Mode	Test Position	SAR(W/Kg), 1.6 (1g average)		
		Channel/		
		1	6	11
802.11b	Back Upward	0.342	0.244	0.237
	Camera Upward	---	0.236	---
	Left side Upward	---	0.098	---

Remark: *Per KDB 447498, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.*

9.3 Simultaneous Multi-band Transmission SAR Analysis

List of Mode for Simultanous Multi-band Transmission

No.	Configurations	Head SAR	Body-worn SAR	Hotspot SAR
1	GSM + WLAN	---	---	---
2	WCDMA + WLAN	---	---	---
3	GPRS + WLAN (Hotspot)	---	---	---
4	GSM + Bluetooth	---	---	---
5	WCDMA + Bluetooth	---	---	---
6	GPRS + Bluetooth (Tethering)	---	---	---

Remark:

1. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.

2. According to the KDB 447498 D01v05r01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;

where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.

For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r01 as below:

Bluetooth Max. Power (dBm)	Frequency (GHz)	Exposure Position	Head	Hotspot	Body-worn
		Test sparation	0 mm	10 mm	10 mm
		Antenna to user distance	5 mm	10 mm	10 mm
---	---	Estimated SAR (W/kg)	---	---	---

3. The maximum SAR summation is calculated based on the same configuration and test position. If 1g-SAR scalar summation < 1.6W/kg, simultaneous SAR measurement is not necessary.

10. Measurement Uncertainty

10.1 Uncertainty for EUT SAR Test

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	7.00	7.00	∞
Axial Isotropy	E.2.2	2.5	R	√3	(1_Cp)^1/2	(1_Cp)^1/2	1.02	1.02	∞
Hemispherical Isotropy	E.2.2	4.0	R	√3	(Cp)^1/2	(Cp)^1/2	1.63	1.63	∞
Boundary effect	E.2.3	1.0	R	√3	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	√3	1	1	2.89	2.89	∞
System detection limits	E.2.5	1.0	R	√3	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	∞
Reponse Time	E.2.7	3.0	R	√3	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	√3	1	1	1.15	1.15	∞
RF ambient Conditions	E.6.1	3.0	R	√3	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	√3	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	√3	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	5.0	R	√3	1	1	2.89	2.89	∞
Test Sample Related									
Test sample positioning	E.4.2.1	0.03	N	1	1	1	0.03	0.03	N−1
Device Holder Uncertainty	E.4.1.1	5.00	N	1	1	1	5.00	5.00	
Output power Variation - SAR drift measurement	6.6.2	12.02	R	√3	1	1	6.94	6.94	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	√3	1	1	0.03	0.03	∞
Liquid conductivity - deviation from target value	E.3.2	5.00	R	√3	0.64	0.43	1.85	1.24	
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.20	2.15	
Liquid permittivity - deviation from target value	E.3.2	0.37	R	√3	0.6	0.49	0.13	0.10	
Liquid permittivity -	E.3.3	10.00	N	1	0.6	0.49	6.00	4.90	M

measurement uncertainty									
Combined Standard Uncertainty		RSS					12.98	12.53	
Expanded Uncertainty (95% Confidence interval)		K=2					25.32	24.43	

10.2 Uncertainty for System Performance Check

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	7.00	7.00	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	$(1\_Cp)^{1/2}$	$(1\_Cp)^{1/2}$	1.02	1.02	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	$(Cp)^{1/2}$	$(Cp)^{1/2}$	1.63	1.63	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	∞
Reponse Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Dipole									
Dipole axis to liquid Distance	8,E.4.2	1.00	N	$\sqrt{3}$	1	1	0.58	0.58	N−1
Input power and SAR drift measurement	8,6.6.2	12.02	R	$\sqrt{3}$	1	1	6.94	6.94	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Liquid conductivity - deviation from target value	E.3.2	5.00	R	$\sqrt{3}$	0.64	0.43	1.85	1.24	
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.20	2.15	
Liquid permittivity - deviation	E.3.2	0.37	R	$\sqrt{3}$	0.6	0.49	0.13	0.10	

from target value									
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	1	0.6	0.49	6.00	4.90	M
Combined Standard Uncertainty			RSS				12.00	11.50	
Expanded Uncertainty (95% Confidence interval)			K=2				23.39	22.43	

Annex A. Plots of System Performance Check

Type: Phone measurement (Complete)

      Area scan resolution: dx=8mm,dy=8mm

      Zoom scan resolution: dx=8mm, dy=8mm, dz=5mm

Date of measurement: 8/16/2013

Measurement duration: 13 minutes 21 seconds

A. Experimental conditions.

Phantom File	surf_sam_plan.txt
Phantom	Validation plane
Device Position	
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	2450.000000
Relative permittivity (real part)	52.689490
Relative permittivity	12.991650
Conductivity (S/m)	1.928476
Power Drift (%)	1.080000
Ambient Temperature:	23.2°C
Liquid Temperature:	22.8°C
ConvF:	39.772,33.946,37.835
Crest factor:	1:1

SURFACE SAR	VOLUME SAR
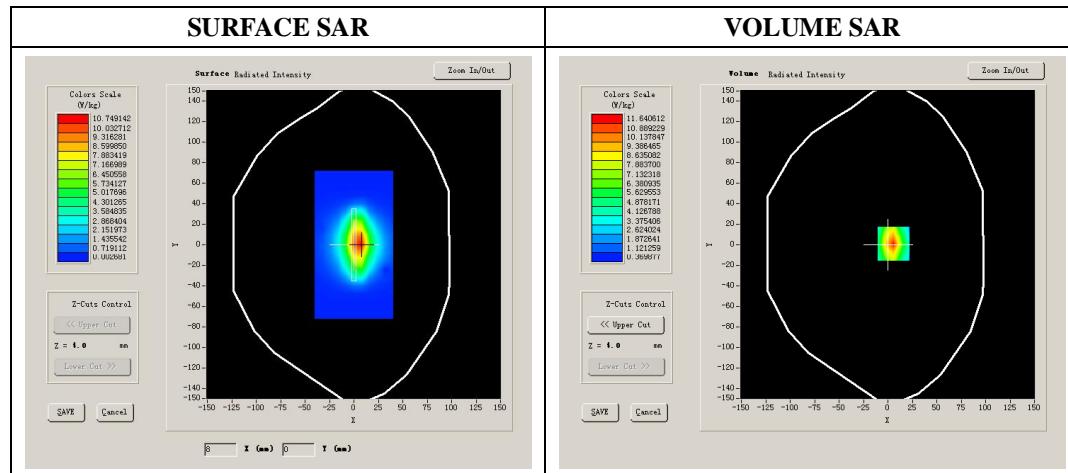
Maximum location: X=7.00, Y=1.00

SAR 10g (W/Kg)	5.940673
SAR 1g (W/Kg)	13.168923

Z Axis Scan

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.0000	13.1279	6.8312	3. 5991	1.3473

3D sceen shot	Hot spot position
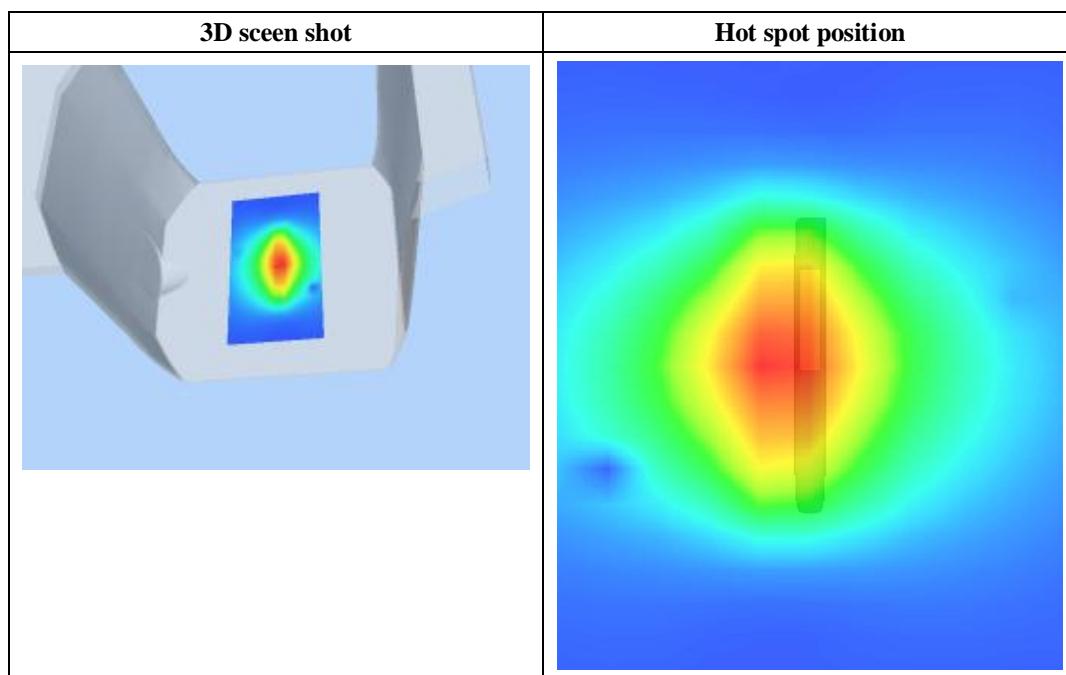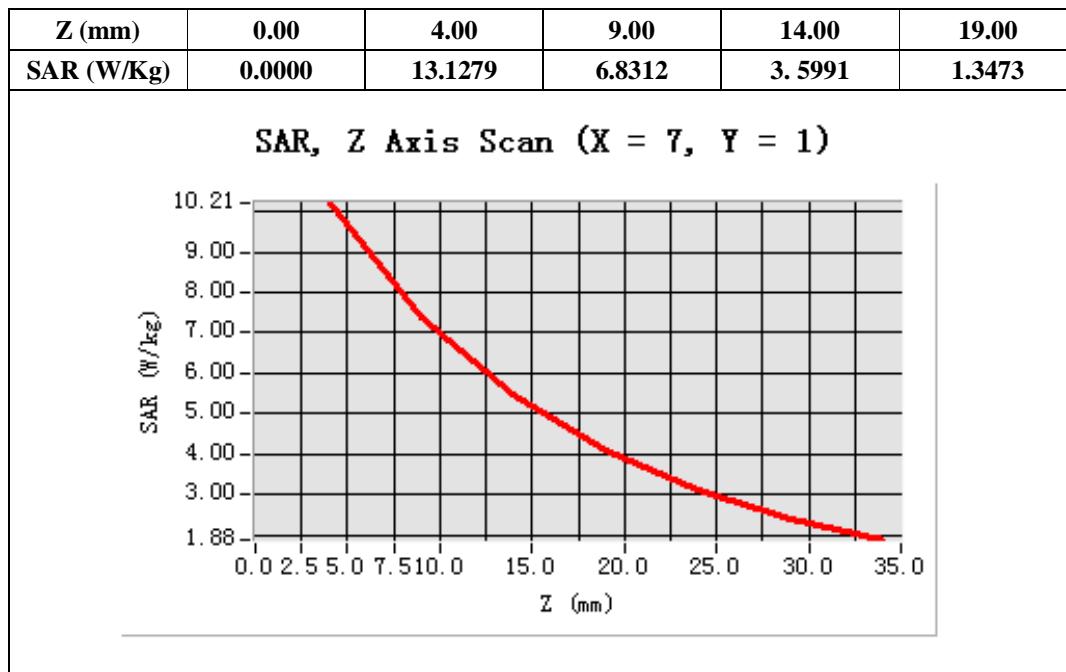
Annex B. Plots of SAR Measurement

Back Upward Test Results(Back Side)

Type: Phone measurement (Fast, 27.00 %)

Date of measurement: 8/16/2013

Measurement duration: 9 minutes 12 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Low
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 1):

Frequency (MHz)	2412.000000
Relative permittivity (real part)	52.550668
Relative permittivity (imaginary part)	14.275111
Conductivity (S/m)	1.919865
Variation (%)	2.120000

SURFACE SAR	VOLUME SAR
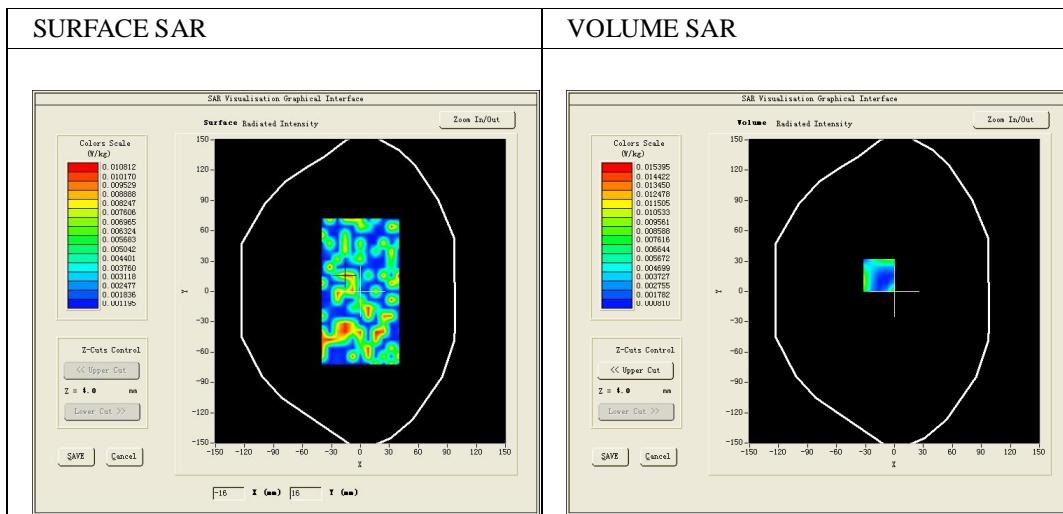
Maximum location: X=-16.00, Y=16.00

SAR Peak: 0.38 W/kg

SAR 10g (W/Kg)	0.082461
SAR 1g (W/Kg)	0.217243

Back Upward Test Results(Back Side)

Type: Phone measurement (Fast, 75.00 %)

Date of measurement: 8/16/2013

Measurement duration: 12 minutes 59 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	52.667335
Relative permittivity (imaginary part)	14.311222
Conductivity (S/m)	1.927580
Variation (%)	-3.919998

SURFACE SAR	VOLUME SAR
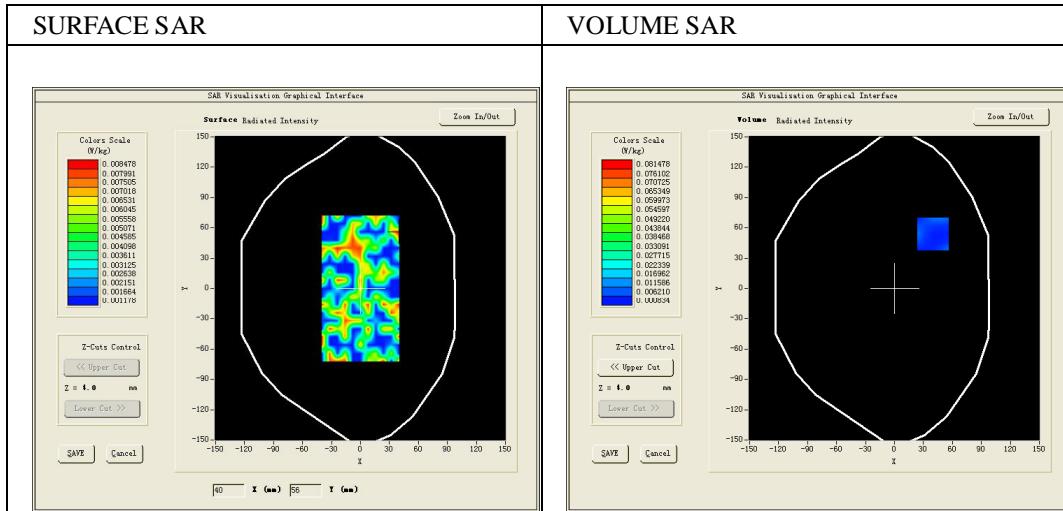
Maximum location: X=-30.00, Y=72.00

SAR Peak: 0.68 W/kg

SAR 10g (W/Kg)	0.092581
SAR 1g (W/Kg)	0.214213

Back Upward Test Results(Back Side)

Type: Phone measurement (Fast, 27.00 %)

Date of measurement: 8/16/2013

Measurement duration: 9 minutes 15 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	High
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 11):

Frequency (MHz)	2462.000000
Relative permittivity (real part)	52.784633
Relative permittivity (imaginary part)	14.275111
Conductivity (S/m)	1.936462
Variation (%)	-2.450000

SURFACE SAR	VOLUME SAR
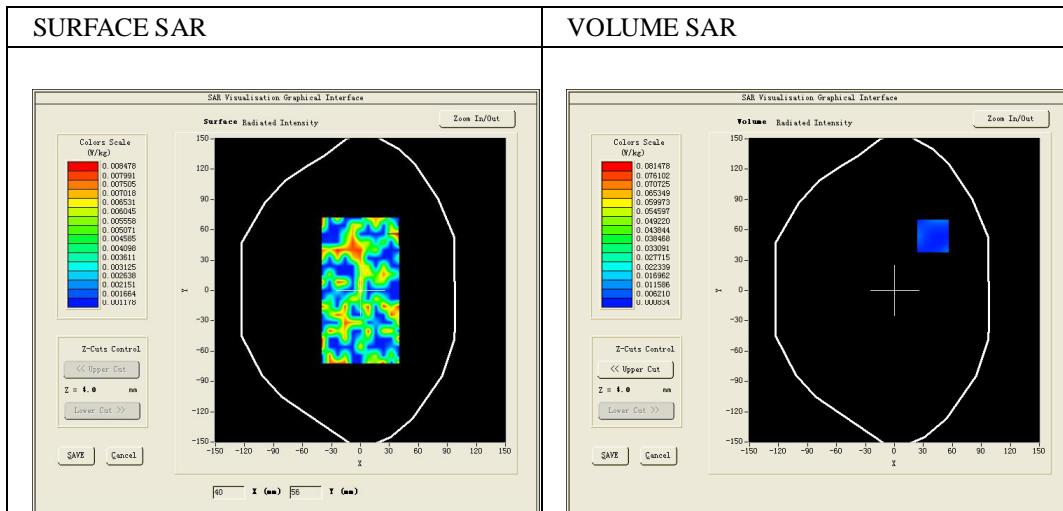
Maximum location: X=40.00, Y=54.00

SAR Peak: 0.33 W/kg

SAR 10g (W/Kg)	0.081235
SAR 1g (W/Kg)	0.211773

Camera Upward Test Results(Top Side)

Type: Phone measurement (Fast, 27.00 %)

Date of measurement: 8/16/2013

Measurement duration: 9 minutes 25 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	52.667335
Relative permittivity (imaginary part)	14.311222
Conductivity (S/m)	1.927580
Variation (%)	4.220000

SURFACE SAR	VOLUME SAR
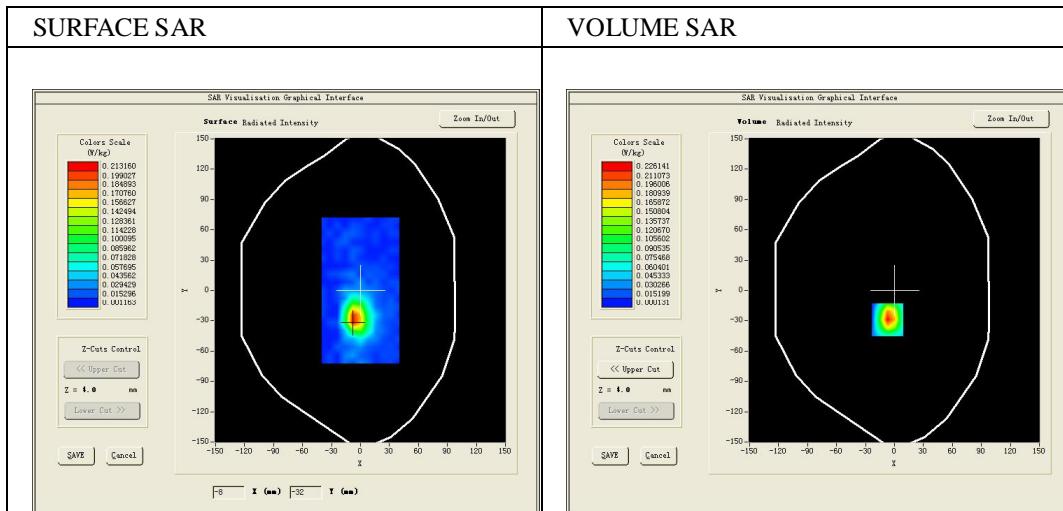
Maximum location: X=-7.00, Y=-29.00

SAR Peak: 0.39 W/kg

SAR 10g (W/Kg)	0.088660
SAR 1g (W/Kg)	0.206988

Left side Upward Test Results(Left side)

Type: Phone measurement (Fast, 27.00 %)

Date of measurement: 8/16/2013

Measurement duration: 8 minutes 55 seconds

Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	surf_sam_plan.txt
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm,Very fast
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b ISM
Channels	Middle
Signal	IEEE802.b (Crest factor: 1.0)

B. SAR Measurement Results

Middle Band SAR (Channel 6):

Frequency (MHz)	2437.000000
Relative permittivity (real part)	52.667335
Relative permittivity (imaginary part)	14.311222
Conductivity (S/m)	1.927580
Variation (%)	4.330000

SURFACE SAR	VOLUME SAR
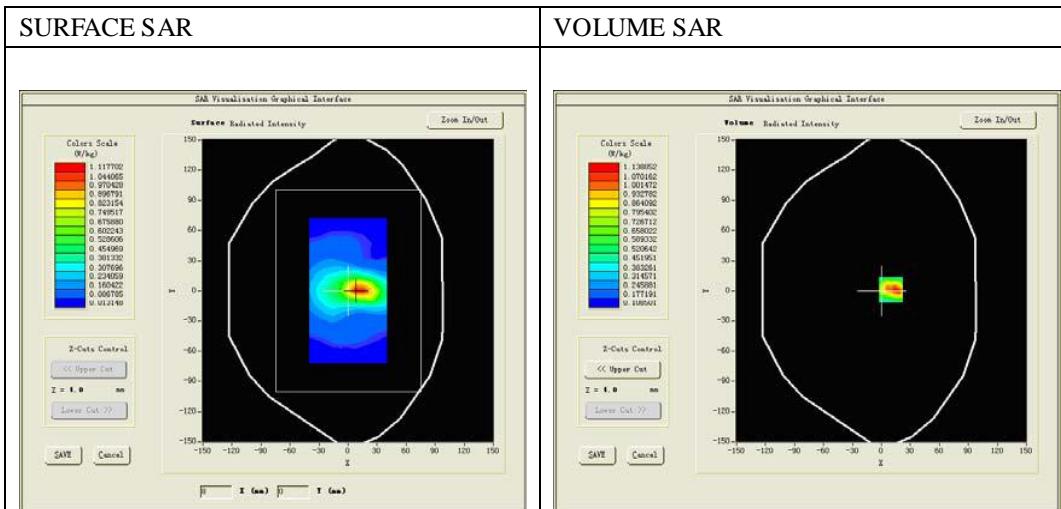
Maximum location: X=10.00, Y=5.00

SAR Peak: 0.34 W/kg

SAR 10g (W/Kg)	0.032153
SAR 1g (W/Kg)	0.086865

Annex C. EUT Photos
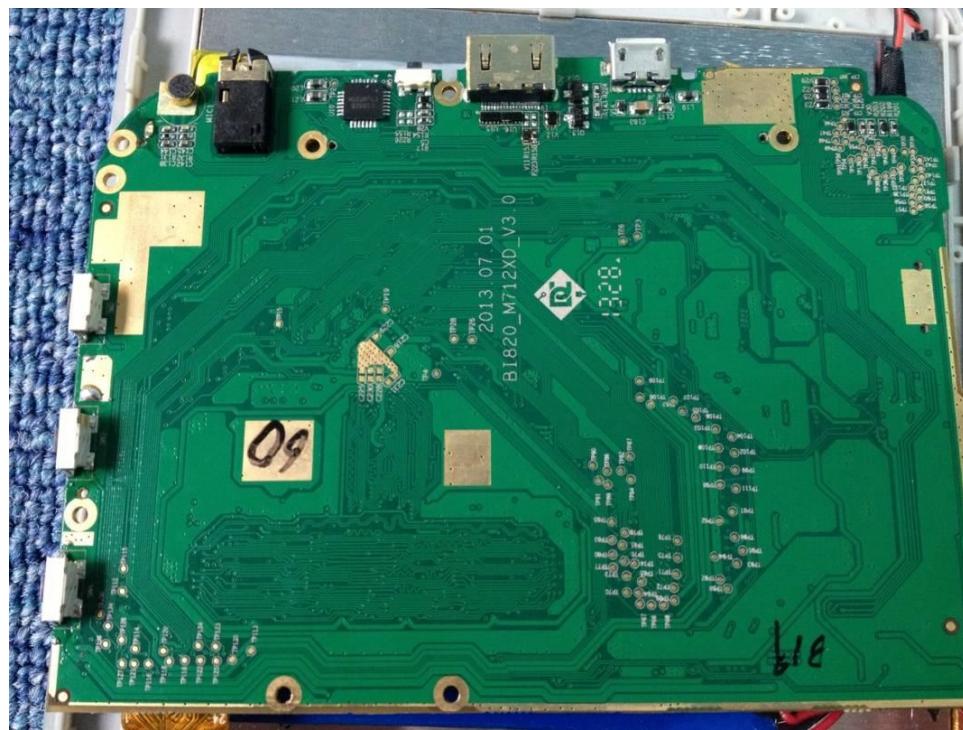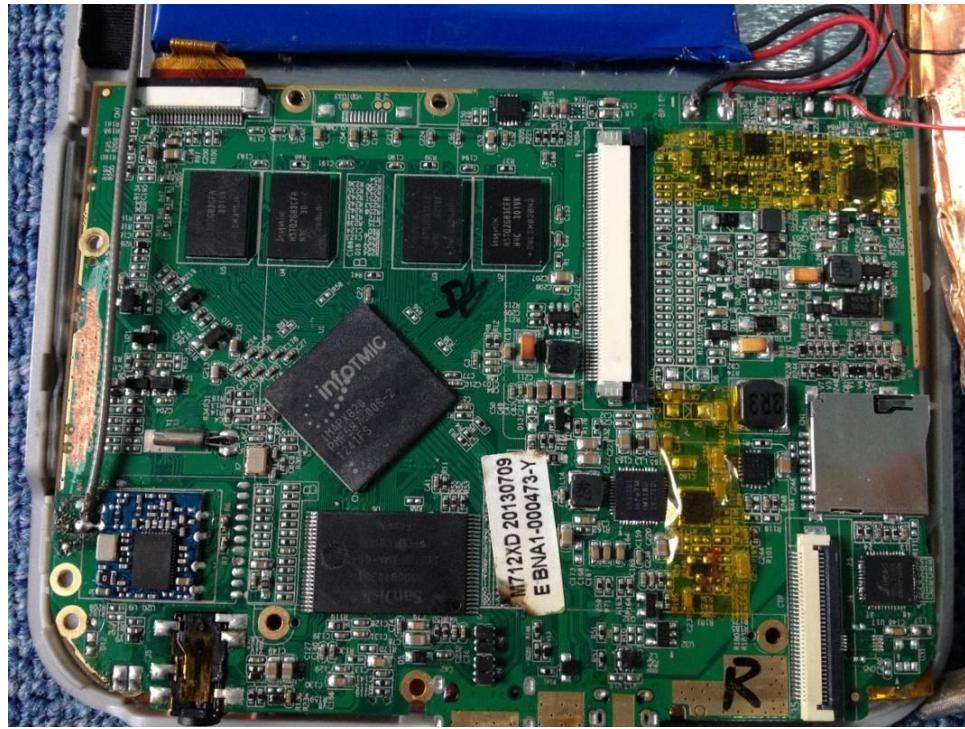
Annex D. Test Setup Photos

Test View

Left side Upward

Back Upward

Camera Upward
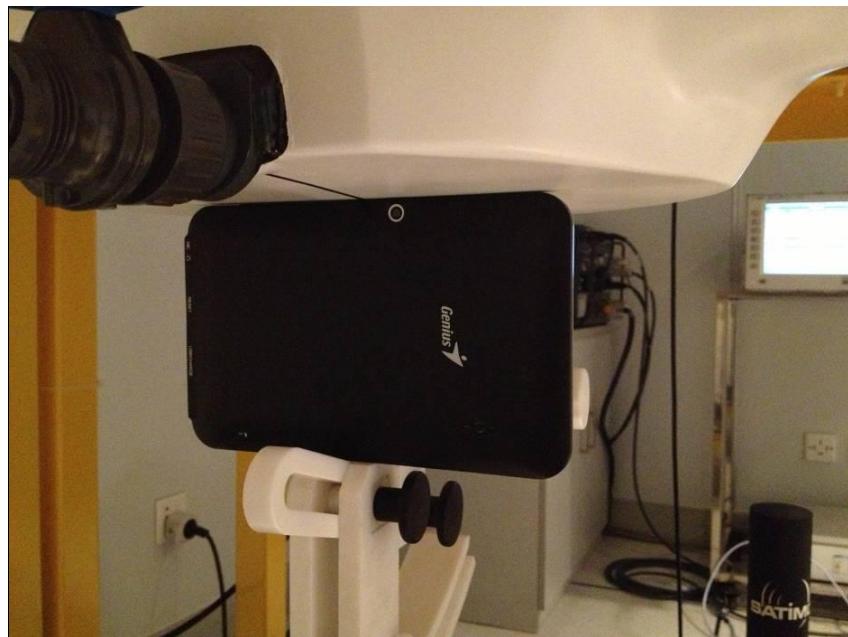
Annex E. Calibration Certificate

SATIMO
The microwave vision company

COMOSAR E-Field Probe Calibration Report

Ref : ACR.96.2.13.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO.,LTD

ELECTRONIC TESTING BUILDING,SHAHE ROAD, XILI. TOWN SHENZHEN,P.R.CHINA

SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 09/13 EP169

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

A2LA ACCREDITED
Calibration CERT #2246.02

04/05/13

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR.96.2.13.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	4/5/2013	
Checked by :	Jérôme LUC	Product Manager	4/5/2013	
Approved by :	Kim RUTKOWSKI	Quality Manager	4/5/2013	

	Customer Name
Distribution :	Shenzhen EMC-united Co., Ltd

Issue	Date	Modifications
A	4/5/2013	Initial release

Page: 2/10

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.96.2.13.SATU.A

TABLE OF CONTENTS

Page: 3/10